

# **Blubber hormones: assessing health and reproduction from dart biopsies**

Nicholas Kellar and Camryn Allen

Researchers, Marine Mammal & Turtle Division

NOAA Fisheries, Southwest Fisheries Science Center

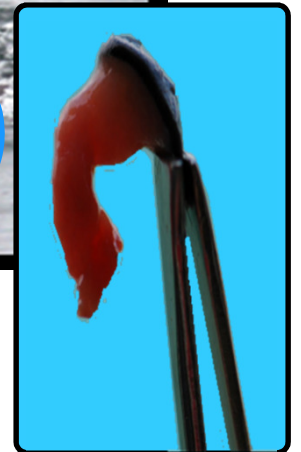
**Review of NOAA Fisheries' Science on Marine Mammals & Turtles**

**Southwest and Northwest Fisheries Science Centers**

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# Why focus on blubber hormones???



Dart biopsies are the biological samples most frequently collected from free-ranging cetaceans. (Note: MMTD curates the largest collection of biopsy samples anywhere)

Typically used for genetic, diet, and contaminant analyses



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## Pioneering the use of blubber hormones as indicators of health and condition

In efforts to maximize these dart biopsy samples, a decade ago our lab, the Marine Wildlife Endocrine Laboratory, developed methods to extract lipophilic hormones from the [blubber](#) attached to most biopsies.

We remain the [only lab anywhere](#) that does this routinely.

We measure a variety of hormones, each giving us a small piece of information about life-history state or health of a sampled animal:

[Progesterone](#) – pregnancy and estrous cycling

[Testosterone](#) – male maturity (proxy for age) and breeding seasonality

[Cortisol](#) – stress response activity, adrenal health, and nutritional state

[Aldosterone](#) – relative blood pressure status, stress response activity, adrenal health, and kidney health

[17-B Estradiol](#) – female sexual maturity and estrous cycling

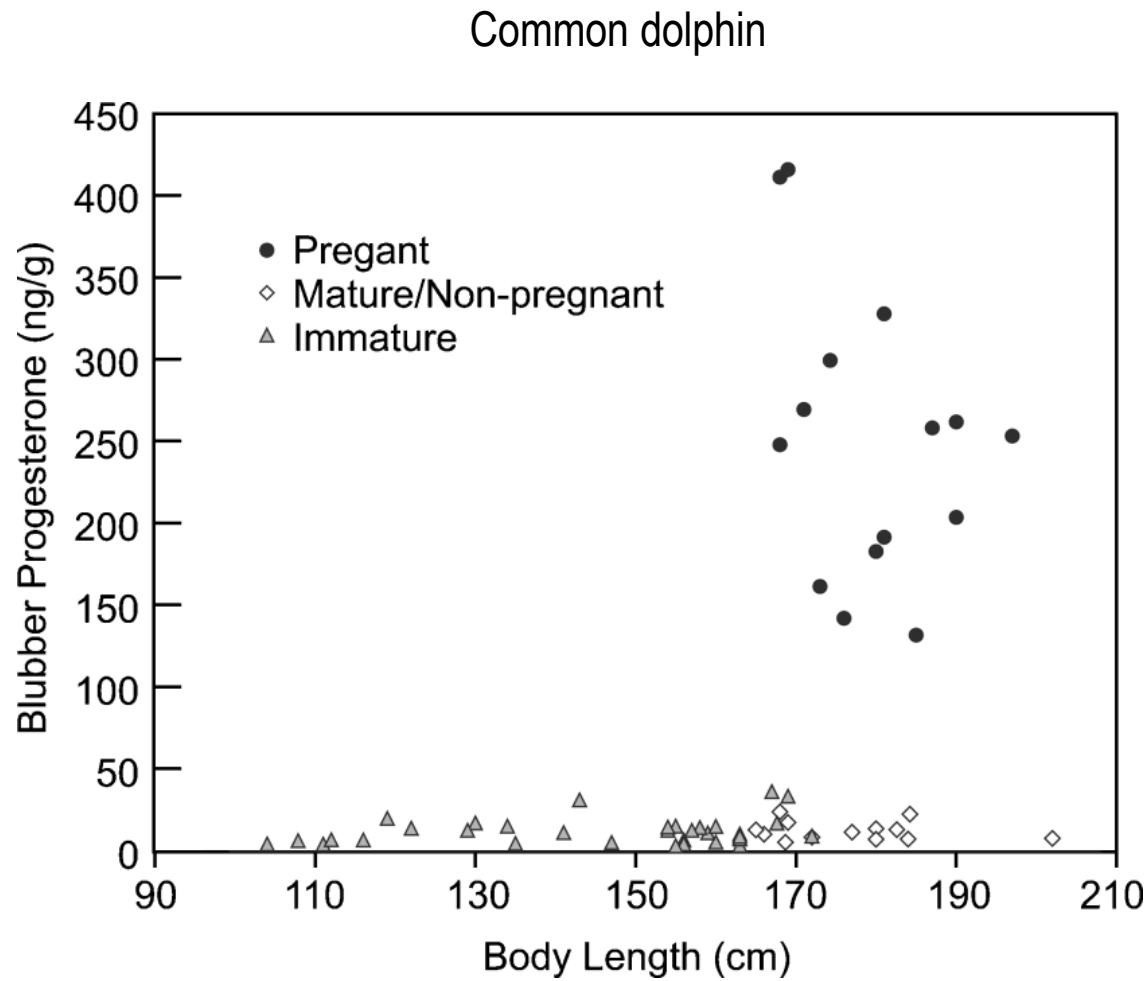
[Thyroid hormones](#) – nutritional state

Moreover, we are pioneering the methods to employ this information to address management questions .



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Blubber progesterone is an excellent indicator of [pregnancy status](#)



Measured blubber progesterone in:

- over 1500 females
- 6 baleen whale species
- 9 dolphin species
- 2 beaked whale species
- 1 porpoise species
- 2 pinniped species

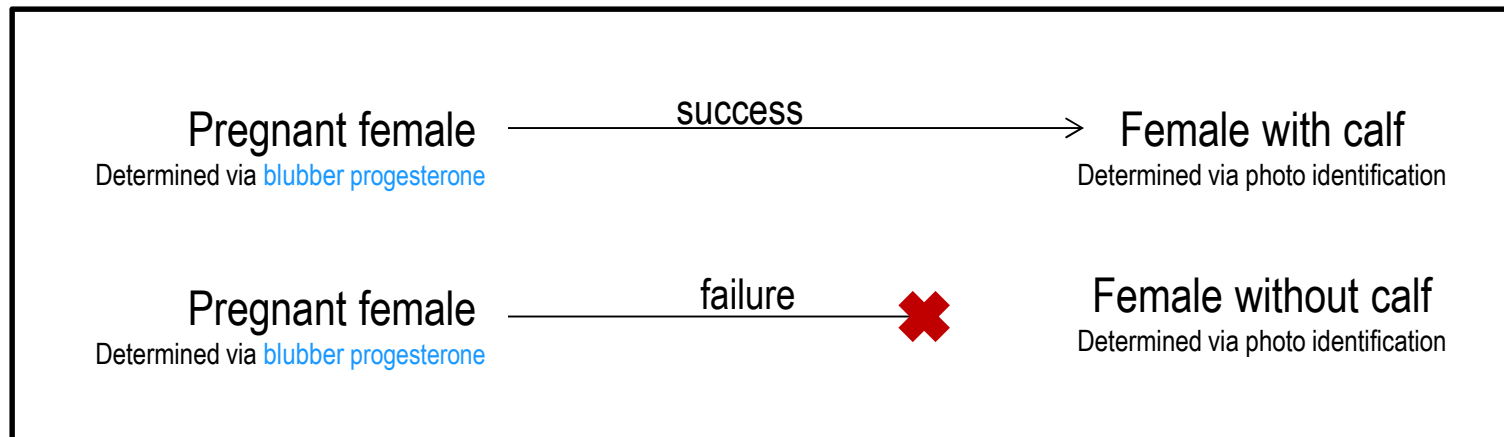


Kellar et al. 2006 Mar Mam Sci



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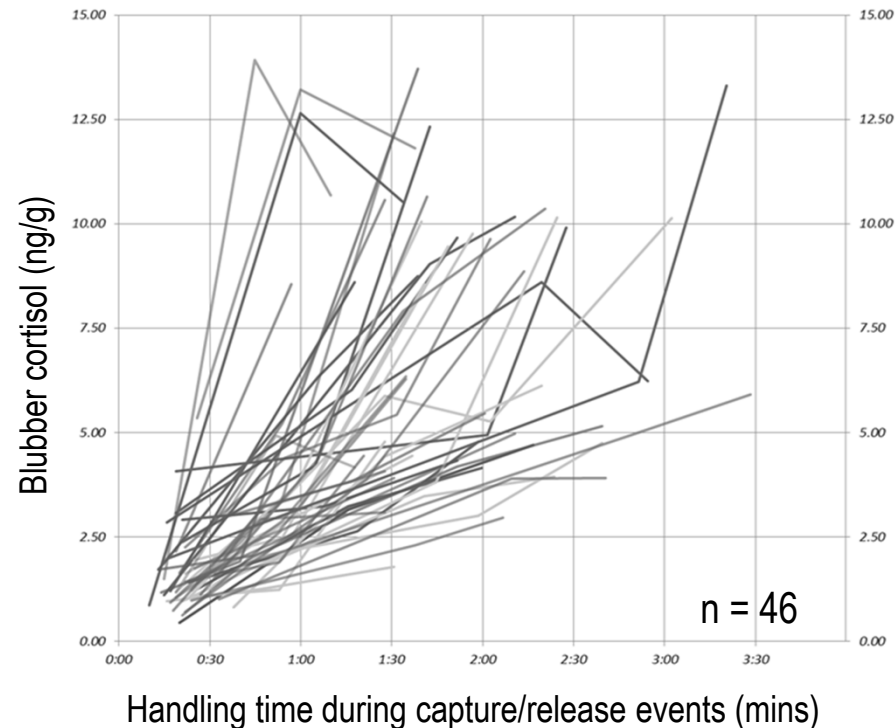
Natural Resources Damage Assessments:  
Deepwater Horizon Oil Spill (2010-2015)  
Refugio Beach Oil Spill (2015)  
(rate of reproductive failure – bottlenose dolphins)



Ongoing analysis: the rate of success is approximately 3-4 times higher in non-oiled areas compared to those that experienced heavy oiling

# Deepwater Horizon – Natural Resources Damage Assessment

(blubber cortisol / adrenal effects – bottlenose dolphins)



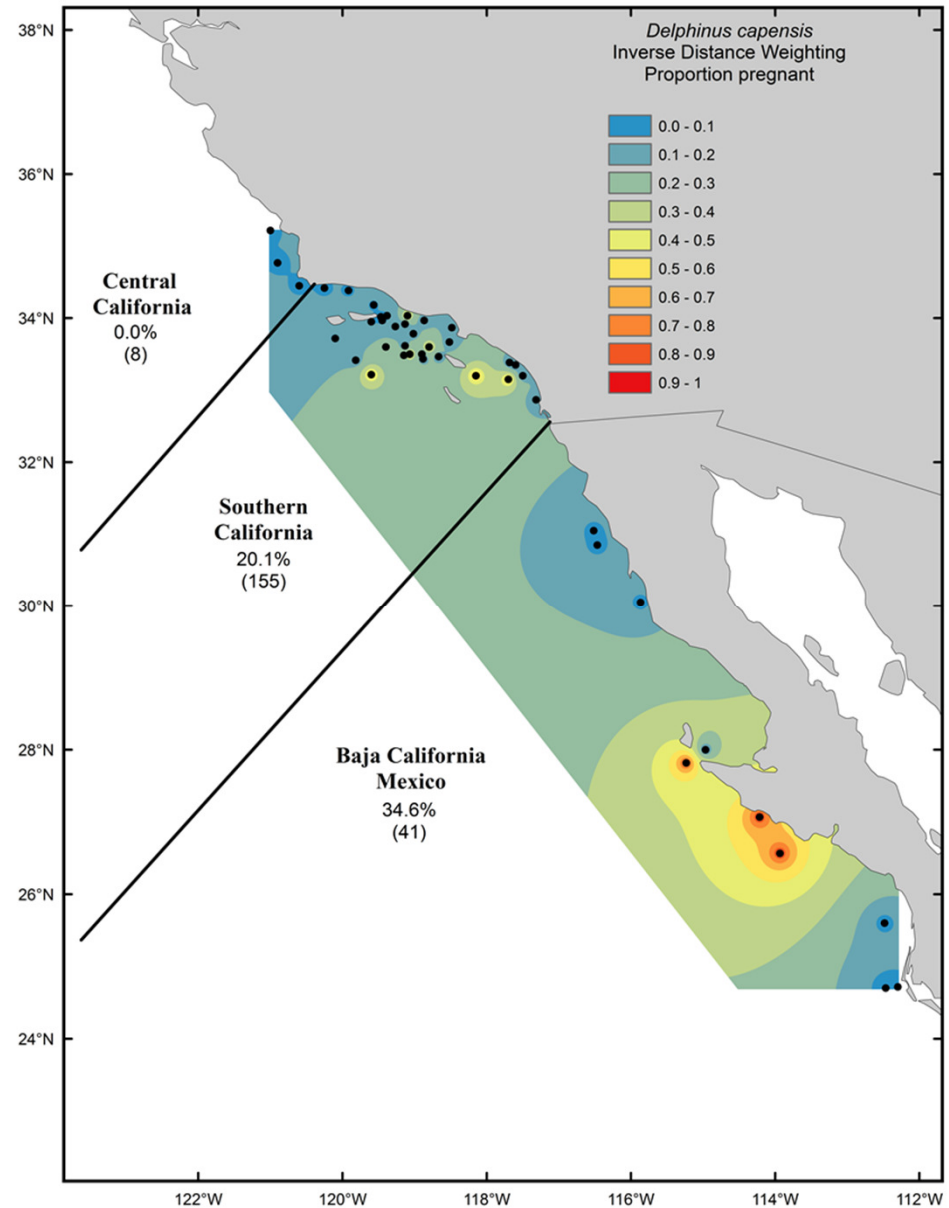
- 1) Blubber cortisol is indicative of **stress response**.  
(stressor here is handling time after capture – sampled (up to 3x) during capture/release assessments)
- 2) There's a lag in the rate of change in blubber hormone concentration compared to that found in the blood. If sampled quickly, the blubber concentrations have no signal artefacts caused by the sampling event itself (i.e., when blubber is collected via dart biopsy).
- 3) Animals with **impaired adrenal glands** have lower rates of cortisol increase as function of stressor duration.



## Mapping results of hormone analysis

Example: Spatial distribution of long-beaked common dolphin pregnancy rates

Pregnancy rates are disproportionately higher the further south and east that we sample long-beaked common dolphins.



Kellar et al. 2014 Mar Mam Sci



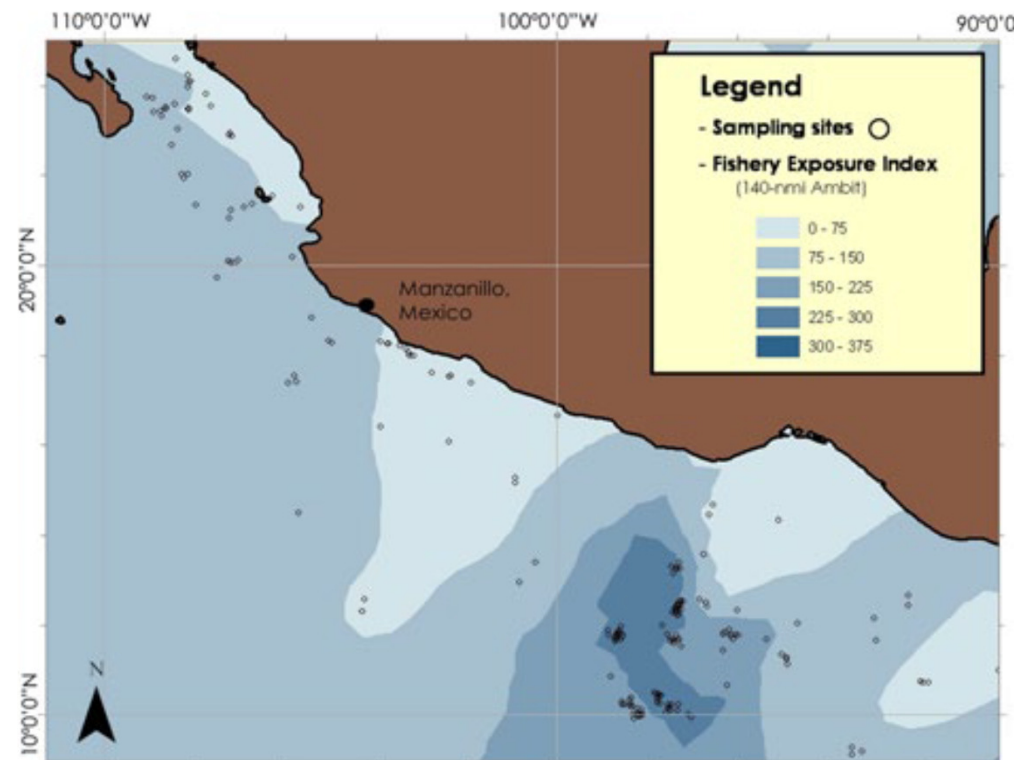
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## Mapping results of hormone analysis

Pregnancy rates of spotted dolphins

Overlay map of relative **fishing effort**

Results are consistent with northeastern spotted dolphins having lower pregnancy rate in areas with higher fishing effort



Mar Biol

**Table 2** Median ( $SE_{\text{median}}$ ) fishery exposure indices, for the two ambits captured, of pregnant and non-pregnant biopsied female pan-tropical spotted dolphin (*S. attenuata*)

Ambit (spatial temporal window)	Median fishery exposure index $\pm SE_{\text{median}}$		<i>p</i> value
	Pregnant ( <i>n</i> = 24)	Non-pregnant ( <i>n</i> = 184)	
140-day	42.4 $\pm$ 41.3	155.9 $\pm$ 6.19	0.0220
180-day	49.7 $\pm$ 43.8	169.0 $\pm$ 4.19	0.0170

Kellar et al. 2013 Mar Bio

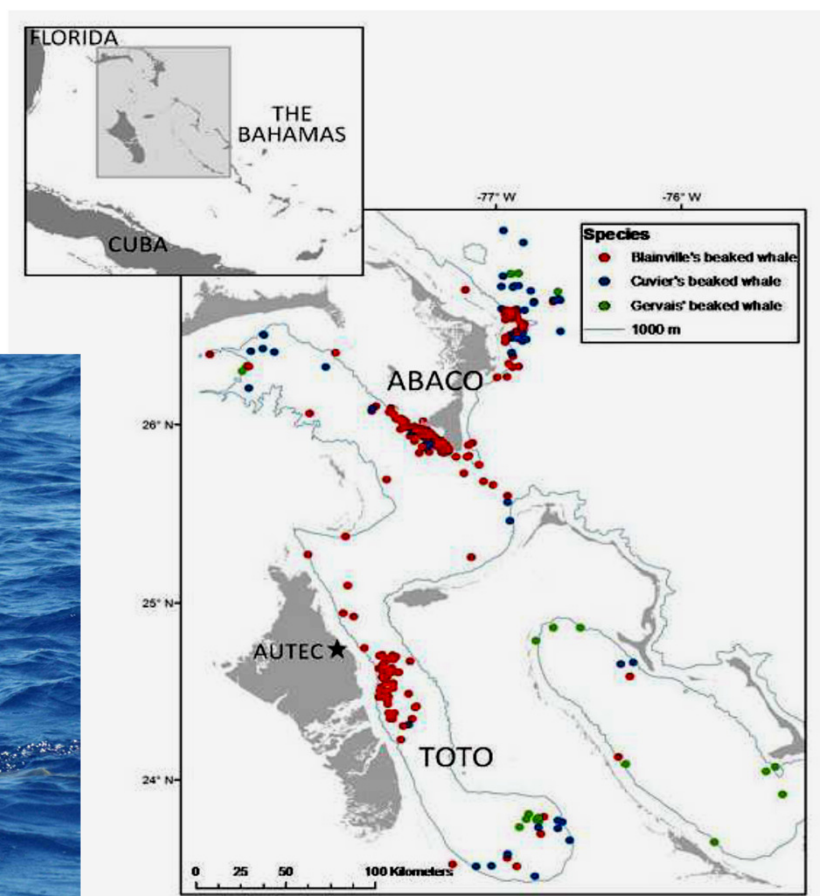


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Navy sonar use – Atlantic Undersea Technical Evaluation Center  
(reproductive rate and cortisol levels)

In a similar fashion we are evaluating the relationships between sonar use, blubber cortisol, and pregnancy rates on Blainville's beaked whales.



## Future directions: new markers and coupling with other technologies

*Nutritional state analysis* – leveraging samples from our legacy collection of stranded and fishery bycatch specimens, we are developing and validating hormone markers of nutritional state. Using measurements of cortisol and thyroid hormones along with % lipid, we are creating a way to estimate body condition or nutritional state from a biopsy.

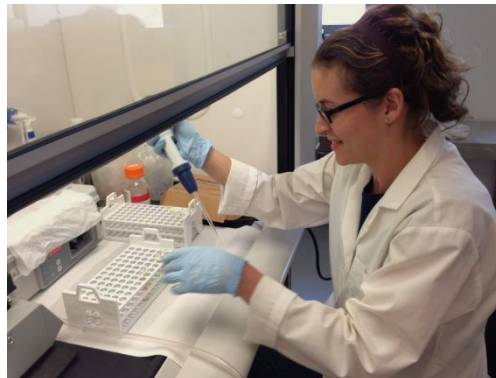
*Breath analysis* – adding hormone analysis of cetacean exhalant (or “whale blow”) will give a better understanding of individual health derived from another organ system. The advantages are two-fold: 1) less impact on the animals and 2) greater variety of potential health markers. Especially, when paired with drone sampling this may be the health sampling matrix of the future.



# Marine Wildlife Endocrine Laboratory



Nicky Beaulieu	Keiko Sherman
Michelle Robbins	Billy Hilton
Nick Kellar	Kipp Searles
Marisa Trego	Daniel Vitenson
Krista Catelani	Kaden Jones
Alexa Kownacki	Sara Mezaros
Camryn Allen	



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